Cardiovascular disease treatment among severe mental illness patients: a data linkage study

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Abstract

Background. Sub-optimal treatment of cardiovascular diseases (CVD) among severe mental illness (SMI) patients may contribute to physical health disparities.

Aims. To identify SMI characteristics associated with meeting CVD treatment guidelines.

Design & setting. Population-based electronic health record database linkage between primary care and the sole provider of secondary mental health care services in South East London, UK

Methods. Cardiovascular disease prevalence, risk factor recording and Quality and Outcomes Framework (QOF) clinical target achievement was compared among 4,056 SMI primary care patients whose records were linked to secondary health care records and 270,669 patients without SMI who were not known to secondary care psychiatric services using multivariate logistic regression modelling. Data available from secondary care records were then used to identify SMI characteristics associated with QOF clinical target achievement.

Results. SMI patients with coronary heart disease and heart failure experienced reduced prescribing of betablocker and Angiotensin-Converting Enzyme Inhibitor/Angiotensin Receptor Blockers (ACEI/ARB). A diagnosis of schizophrenia, being identified with any indicator of risk or illness severity, and being prescribed with depot injectable antipsychotic medication was associated with the lowest likelihood of prescribing.

Conclusions. Linking primary and secondary care data allows the identification of SMI patients most at risk of under treatment for physical health problems.

How this fits in

Patients with severe mental illness (SMI) experience lower life expectancy than the general population and sub-optimal treatment of cardiovascular diseases has been identified as one potential contributory factor. We find that SMI patients in South East London are under-prescribed betablockers and ACE Inhibitors/Angiotensin Receptor Blockers as secondary prevention following coronary heart disease (CHD) and heart failure (HF). Patients with schizophrenia, those prescribed depot injectable antipsychotic medication, those with more severe illness and those identified with any indicator of 'risk' are the least likely to be prescribed these medications following CHD and HF. This may help clinicians identify patients at greatest risk of sub-optimal treatment.

Introduction

Patients with severe mental illness (SMI), including schizophrenia, bipolar affective disorder, schizoaffective disorder or other non-organic psychoses, experience lower life expectancy than the general population.[1-4]This is largely attributed to common physical disorder, particularly cardiovascular diseases (CVDs)[2, 3, 5, 6]Excess mortality linked to CVDs is attributed to several factors, including elevated

risk factors such as smoking; side effects of pharmacological treatment; diagnostic overshadowing; and, sub-optimal management of co-morbid physical conditions.[7-14] Previous studies have been unable to investigate associations for varying SMI-related characteristics since data on physical health and clinical management sits mainly within primary care while mental health condition and management records are mainly stored in secondary care.

We use London borough population-based data from a linkage of primary, and secondary mental health care records to: compare CVD prevalence, risk factor recording and treatment for established CVD, and primary care consultation frequency by SMI status; examine whether SMI illness characteristics are differentially associated with CVD prevalence and treatment; and, assess the impact of adjustments for consultation frequency.

Methods

Setting & data sources

Lambeth is a diverse borough in South East London, with a greater number of Black Caribbean and Black African residents but fewer South Asian residents than other areas,[15] and is more deprived than England as a whole.[16]Pseudonymised primary care data were extracted on 31st March 2013 from computerised medical records of all except one GP practice (n=48) within Lambeth, as part of Lambeth DataNet (LDN) covering a population of 366,317 registered patients. This was a cross-sectional extract of LDN, but for some records (e.g., BP), information on all measures recorded during 31st January 2012 to 31st October 2013 were collected to determine whether Quality and Outcomes Framework (QOF) (an annual reward and incentive programme detailing GP practice achievement results [17]) clinical targets had been met. Secondary care data came from the Case Register Interactive Search (CRIS),[18]an application allowing researchers access to pseudonymised electronic health record (EHR) data from the South London and Maudsley NHS Foundation Trust (SLaM). CRIS provides searchable access to de-identified text (unstructured data) from the clinical record.

Data linkage

Data were linked and stored by the Clinical Data Linkage Service (CDLS) which provides a safe haven environment with strict governance arrangements. Data were linked using encrypted NHS numbers which were subsequently removed and destroyed, fully anonymising the linked dataset.

Measures

Lambeth DataNet (LDN)

Data were extracted on gender, year of birth, ethnicity, and 2011-defined lower super output area (LSOA). LSOA data were used to estimate deprivation on the basis of patient area of residence using the Index of Multiple Deprivation (IMD-2010) and a conversion to 2011 LSOA values. GP clinical register data (lists established and maintained by practices of patients identified with particular clinical outcomes for

QOF purposes) were collected for heart failure (HF), coronary heart disease (CHD), hypertension (HYP) and stroke/transient ischaemic attack (STIA). Data were also collected on CVD risk factor recording, e.g., blood pressure (BP); clinical values and dates; and, mean number of primary care consultations (including GP, nurse, face-to-face, and telephone) between 2010 and 2013. A binary variable was created to distinguish median or below and above median mean annual number of consultations.

Case Register Interactive Search (CRIS)

Diagnostic codes for any primary or secondary diagnosis of schizophrenia, bipolar affective disorder, and schizoaffective disorder or other non-organic psychoses were extracted. An indicator of SMI severity was created coding SMI patients as 1 if they ever had a record of an inpatient stay, being treated under the Mental Health Act, difficulty managing their physical health, or contact with Assertive Outreach, Crisis or A&E liaison team (or 0 if they had not been recorded with any of these). Similarly, an indicator of risk coded SMI patients as 1/0 to indicate if they had ever been identified under the 'violence and aggression' subscale of risk assessment with a history of violence, non-compliance, or forensic history. Lastly, binary indicators of antipsychotic medication prescription were extracted - including binary indicators of atypical, typical, and depot injectable medication.

Statistical analyses

Pearson's chi squared tests and logistic regression analyses were used to compare CVD prevalence, risk factor recording, QOF target achievement, and primary care consultation frequency by SMI status. Using linked data, comparisons by SMI status in CVD prevalence and prescribing were then examined by individual SMI characteristics. Logistic regression analyses were used to assess whether any differences in CVD prevalence or prescribing could be accounted for by adjustment for socio-demographic characteristics and consultation frequency. P-values, unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI) are shown. Due to the large number of statistical tests conducted, we used an alpha level of $p<0.01$ to determine statistical significance. All analyses were conducted using STATA v12.[19]

Results

Data were obtained for LDN patients aged 16+ years (n=295,301); of these, 8.1% (n=23,919) were linked to secondary mental health care records. Among those with linked records, n=4056 (16.9%) were recorded with SMI by their GP in LDN. Analyses compared those with recorded SMI in primary care with linked secondary care records (n=4056) to those not recorded with SMI in primary care or linked to secondary care (n=270,669).

Socio-demographics, CVD prevalence and consultation frequency among patients with and without SMI

SMI status was associated with gender, age, ethnicity, deprivation, consultation frequency, and greater prevalence of CVDs (Table 1). In patients with an established CVD (data not shown) there were no longer associations between SMI status and gender, nor age among patients with CHD or STIA. SMI status was

only associated with ethnicity and GP consultation rate among HYP patients and SMI status was no longer associated with deprivation among patients with any CVD condition.

Socio-demographic characteristics of SMI sub-groups

The SMI characteristics extracted from secondary care data are illustrated in Table 2. Adjusting for all socio-demographic characteristics simultaneously (data not shown), being Black African, Black Caribbean, other Black and younger age was associated with indicators of risk and severity, and with receiving depot injectable antipsychotic medication; male gender was also associated with risk. Being Black Caribbean and older was associated with receipt of typical antipsychotics, while younger age and being Black African was associated with receipt of atypical antipsychotics. Relative to those with a diagnosis of schizophrenia, those diagnosed with bipolar disorder were younger, more likely to be identified as British/mixed British, female, and to consult primary care more frequently (p=0.01). Those diagnosed with schizoaffective disorder/other non-organic psychoses were younger, more likely to be female, and to consult primary care less frequently relative to schizophrenia patients (except where indicated, all p-values <0.001).

CVD risk factor recording and QOF target achievement

CVD risk factor recording (e.g. BP) was in general high for patients with and without SMI (Table 3). Among those with established CVDs, SMI patients were more likely to have a record of their alcohol intake. Among HYP patients, SMI status was also associated with greater recording of BMI and HbA1c levels. SMI patients with CHD were less likely to have a BP record, while those with STIA were less likely to have a record of BP and smoking status. CVD risk assessment (e.g. Framingham risk score) was significantly less common among SMI patients. Despite significantly higher prevalence of CVDs in the SMI group overall, there was little or no difference in the prevalence of co-morbid CVDs or diabetes by SMI status among those with established CVDs. Among HYP patients, diabetes was significantly more common among SMI than non-SMI patients.

For most QOF targets, there was no significant difference between SMI and non-SMI patients. For SMI patients with HF and CHD, a significant shortfall was observed in prescribing with ACE inhibitors or angiotensin receptor blockers (ACEIs/ARBs) and beta-blockers.

Regression analyses of QOF target achievement

Regression analyses (Table 4) focussed on differences in CVD prescribing by SMI status as these differences have previously been identified as a potential contributor to excess cardiovascular mortality among SMI patients [12] and were the key differences identified in Table 3. Associations between SMI status and beta-blocker and ACEI/ARB medication among HF patients remained after accounting for both socio-demographic characteristics and consultation rates. Among CHD patients, the association between SMI status and betablocker prescription was accounted for by ethnicity but the shortfall in ACEI/ARB prescribing among CHD patients with SMI remained following adjustments.

For analyses examining SMI-subgroups associated with betablocker and ACEI/ARB prescribing, CHD and HF were combined due to small numbers (Table 5). After adjustments, prescribing of betablocker and ACEI/ARB medication among patients with CHD or HF combined was significantly lower for SMI patients overall (OR 0.48 and 0.42, respectively); and, was particularly reduced for patients ever prescribed depot injectable antipsychotic medication (OR 0.22 and 0.32, respectively), those with any indicator of risk (OR 0.25 and 0.22, respectively), those diagnosed with schizophrenia (OR 0.38 and 0.27, respectively) and those with any indicator of SMI severity (OR 0.39 and 0.31, respectively).

Discussion

Summary

We found elevated rates of CVDs among SMI patients; however, there may be under-recording of CVD co-morbidities among SMI patients with established CVDs. Risk factor recording was high, though significant differences by SMI status were identified. Overall, QOF target achievement was not impaired in SMI patients but we found significant consistent associations between SMI status and reduced prescribing of ACEI/ARB and betablocker medication as secondary prevention of CHD and HF. SMI patients with schizophrenia, those identified with any indicator of risk or illness severity, and those ever prescribed depot injectable antipsychotics were least likely to be prescribed ACEI/ARBs and betablockers.

Strengths and limitations

This study makes use of a population-based data linkage between primary and secondary care records. We were able to identify patient and illness-related characteristics associated with recording and treatment of CVDs and to highlight issues warranting further investigation that may best target disparities and reduce inequalities in physical co-morbidity and mortality. The main limitation pertains to the generalisability to other geographical areas; however, our findings are in line with evidence from national and international research, and we believe that this study is proof of principle of the utility of data linkage, which could be used elsewhere to corroborate the findings. While our analyses focus on incentivised QOF targets; it is possible that discrepancies in non-QOF targets may differ.

Comparison with existing literature

While SMI patients were more likely to be recorded with CVDs overall, we found little evidence for elevated rates of CVD co-morbid conditions among those with established CVDs. Previous research has found no difference in the pattern of physical health co- and multi-morbidities by SMI status and lower than expected rates of certain CVDs among SMI patients given higher CVD-related mortality. [3, 21, 22] One of several explanations suggested is that this may be linked to less frequent GP consultations[21, 22]; however, we report elevated consultation rates among SMI patients overall, and among SMI patients with established CVD, in line with previous findings.[23] SMI patients were less likely to have a CVD risk assessment, and while such tools may not be as accurate for the SMI population,[24, 25]it is unclear whether this concern - or other factors accounted for this observation.

Lower than expected CVD co-morbidities may also be linked to increased CVD-related mortality, since we found that SMI patients with established CVDs were under-represented in older age groups. We also found lower than expected differences in the proportion of Black SMI patients among those with CHD and HYP. This suggests that for these patients, either SMI status does not confer an excess risk of these outcomes; that unlike other ethnic groups, compared to those without SMI, CHD and HYP is not elevated for Black SMI patients; or, that CHD and HYP is less frequently recorded among Black SMI patients; for example, due to excess mortality.

Treatment differences

In line with previous findings,[7, 14, 22, 26] we found evidence for reduced prescription of ACEI/ARB and betablocker medications for CVD secondary prevention. Under-prescribing in CVDs has been previously linked with excess mortality among SMI patients[7, 12, 22, 26, 27]and therefore may contribute to disparities in life expectancies. Reduced ACEI/ARB prescribing in CHD among SMI patients could partly reflect differences in the effectiveness of these drugs as hypotensive agents among Black Caribbean and Black African patients.[28]National Institute for Health and Care Excellence (NICE) HYP guidelines[29] indicate prescribing of ARBs rather than ACEIs among Black patients; however, the associations remained after adjustments for ethnicity and were robust when ACEIs and ARB prescriptions were analysed separately. Reduced prescribing is also unlikely linked to reduced attendance at primary care since we found greater consultation frequency among SMI patients and adjustments strengthened negative associations with prescribing.

There may, however, be reluctance to prescribe certain CVD medications due to concerns about adherence. Adherence may be lower for drugs where the dose has to be up-titrated to maximally tolerated doses as for beta-blockers and ACEI/ARBs; these medications require monitoring, and thus adherence to a monitoring regime to assess for side-effects. Monitoring also involves regular blood tests; such a commitment may be perceived as too demanding for GPs assessing SMI patients, and/or SMI patients may be less willing to commit themselves to such monitoring. However, a recent US study assessing adherence in patients with and without schizophrenia found no evidence for reduced adherence to ACEI/ARB medication.[30] One reason previously suggested for reluctance to prescribe certain cardiovascular medications is the potential for harm in overdose.[14, 22] While research does not support an association between cardiovascular medication and excess suicide, [31, 32] practitioners could conceivably have concerns around correct adherence among SMI patients, for example, leading to accidental overdose.

Further quantitative and qualitative work may usefully further explore these explanations. Qualitative evidence suggests that primary care physicians may view SMI patients as harder to manage [32, 33] and be less willing to intervene when cardiovascular risk factors are identified.[34] Further, there may be reluctance among SMI patients to accept prescriptions due to mistrust or lack of adequate communication between physician and patient.[35] For patients with greater illness severity, the role of secondary care physicians may be more pertinent in managing physical health.

Lastly, QOF exception rates (e.g. due to informed dissent or treatment unsuitability) are higher in SMI patients, [36, 37] potentially inflating QOF achievement. However, our analyses did not exclude exception reported patients, so our reported achievement rates were not influenced by exception reporting among SMI patients.

SMI subgroups

Betablocker and ACEI/ARB prescription was reduced in SMI patients with CHD or HF overall, but the reduction was greatest in SMI patients identified with any indicator of risk, prescription of depot injectable antipsychotics, schizophrenia diagnosis, and any indicator of SMI severity. While these associations have not been previously investigated to our knowledge, Laursen et al.[25]reported that rates of 'unnatural' deaths were elevated among patients with SMI who were not prescribed cardiovascular medication, also indicating an association with illness severity. The sub-groups identified as most at risk of under-prescribing may be those most likely to be seen as the 'hardest to treat' by GPs and those least likely commit to the monitoring and follow-up as implied above. Further qualitative work should explore these associations among clinicians and patients who have been identified as at risk of under-prescribing.

Implications

Our findings deepen the understanding of disparities in morbidity and healthcare among individuals with SMI and help to build possible explanations for these discrepancies by identifying characteristics of SMI patients associated with the lowest likelihood of optimal treatment. Our findings underline the value of closer working between primary and secondary care in improving outcomes for SMI patients.

Ethics: The linkage was a service evaluation and did not require ethical approval. Approvals for the database linkage were obtained via a Section 251 application to the Health Research Authority (reference: CAG 6-07(f)/2013) and from the Lambeth Clinical Commissioning Group (CCG) Information Governance committee.

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Table 1 Socio-demographic characteristics and CVD prevalence by severe mental illness (SMI) status

	Non-SMI (N=270,669)	SMI (N=4,056)	
	n (%)	*n* (%)	p
Sex[†]			<0.001***
Female	137353 (50.8)	1797 (44.3)	
Male	133315 (49.3)	2259 (55.7)	
Age group			<0.001***
16-24	32776 (12.1)	162 (4.0)	
25-34	88062 (32.5)	678 (32.5)	
35-44	59279 (21.9)	907 (22.4)	
45-54	42839 (15.8)	1095 (27.0)	
55-64	23734 (8.8)	624 (15.4)	
65-74	14035 (5.2)	347 (8.6)	
75+	9944 (3.7)	243 (6.0)	
Ethnicity			<0.001***
British/mixed	78332 (35.0)	1124 (31.6)	
Irish	5253 (2.4)	104 (2.9)	
Indian/Pakistani/Bangladeshi/mixed	16042 (7.2)	219 (6.2)	
Caribbean/mixed	21401 (9.6)	840 (23.7)	
African/mixed	27286 (12.2)	545 (15.3)	
Chinese/other	10871 (4.9)	90 (2.5)	
Other white	54080 (24.2)	373 (10.5)	
Other black	6262 (2.8)	188 (5.3)	
Other mixed	4254 (1.9)	69 (1.9)	
Deprivation quintile			<0.001***
Most deprived	47162 (18.1)	1004 (25.0)	
2	54656 (21.0)	918 (22.9)	
3	54342 (20.9)	836 (20.8)	
4	57149 (22.0)	713 (17.8)	
Least deprived	47054 (18.1)	543 (13.5)	
Consultations			
Mean (SD)	*4.7 (4.3)*	*9.4 (8.0)*	
Median/below	123501 (53.1)	813 (20.9)	<0.001***
Above median	109286 (47.0)	3074 (79.1)	
Cardiovascular diseases			
Hypertension	28010 (10.4)	762 (18.8)	<0.001***
Coronary heart disease	4109 (1.5)	97 (2.4)	<0.001***
Heart Failure	1259 (0.5)	45 (1.1)	<0.001***
Stroke/transient ischaemic attack	2544 (0.9)	100 (2.5)	<0.001***

***p<0.001

[†] One patient recorded as sex "unknown". SMI patients are those known to both primary and secondary care, non-SMI patients are those known only to primary care and not registered with SMI. 'Consultations' refers to mean number of GP and nurse telephone, face-to-face and home primary care consultations per calendar year between 2010 and 2013.

Table 2 Indicators of severity and risk identified from secondary care data among patients with severe mental illness (SMI)

	SMI (N=4056)
	n (%)
Diagnosis	
Schizophrenia	1721 (53.6)
Bipolar affective disorder	716 (22.3)
Other non-organic psychoses	773 (24.1)
Indicator of severity, ever:	2147 (53.0)
Treated under Mental Health Act	1416 (34.9)
Inpatient	1927 (47.5)
Seen by crisis team	23 (0.6)
Seen by assertive outreach	11 (0.3)
A & E outpatient episode	445 (11.0)
Difficulty managing physical health	676 (16.7)
Indicator of risk, ever:	1751 (43.0)
History of non-compliance	1296 (32.0)
History of violence	1171 (28.9)
Forensic history	620 (15.3)
Antipsychotics, ever:	
Depot injectable	1112 (32.3)
Atypical	3255 (94.5)
Typical	1506 (43.7)

Table 3 CVD risk factor recording and QOF CVD target achievement by serious mental illness (SMI) status and among patients with CVD conditions.

	Heart failure (HF)			Coronary heart disease (CHD)			Hypertension (HYP)			Stroke/transient ischaemic attack (STIA)		
	Non-SMI (n=1259)	SMI (n=45)		Non-SMI (n=4109)	SMI (n=97)		Non-SMI (n=28010)	SMI (n=762)		Non-SMI (n=2544)	SMI (n=100)	
Risk Factor recording	*n (%)*	*n (%)*	*p*	*n (%)*	*n (%)*	*p*	*n (%)*	*n (%)*	*p*	*n (%)*	*n (%)*	*p*
BP record	1251 (99.4)	44 (97.8)	0.206	4079 (99.3)	94 (96.9)	0.009**	27859 (99.5)	754 (99.0)	0.061	2519 (99.0)	96 (96.0)	0.004**
Smoking status record	1257 (99.8)	45 (100.0)	0.789	4099 (99.8)	96 (99.0)	0.133	27977 (99.9)	759 (99.6)	0.034*	2537 (99.7)	97 (97.0)	<.001***
HbA1c record	805 (63.9)	26 (57.8)	0.398	2728 (66.4)	67 (69.1)	0.580	16468 (58.8)	531 (69.7)	<.001***	1544 (60.7)	69 (69.0)	0.095
Cholesterol record	1206 (95.8)	45 (100.0)	0.160	4017 (97.8)	94 (96.9)	0.576	26880 (96.0)	734 (96.3)	0.618	2441 (96.0)	94 (94.0)	0.336
BMI record	1187 (94.3)	45 (100.0)	0.099	3849 (93.7)	94 (96.9)	0.193	26386 (94.2)	743 (97.5)	<.001***	2317 (91.1)	95 (95.0)	0.174
Alcohol record	992 (78.8)	45 (100.0)	0.001***	3325 (80.9)	88 (90.7)	0.015*	22637 (80.8)	716 (94.0)	<.001***	1966 (77.3)	92 (92.0)	0.001***
eGFR record	1229 (97.6)	44 (97.8)	0.945	3987 97.0)	94 (96.9)	0.943	26854 (95.9)	731 (95.9)	0.936	2415 (94.9)	96 (96.0)	0.631
CVD risk factor assessment	236 (18.8)	10 (22.2)	0.558	727 (17.7)	11 (11.3)	0.104	9995 (35.6)	230 (30.2)	0.002**	460 (18.1)	14 (14.0)	0.297
TSH record	1140 (90.6)	40 (88.9)	0.709	3619 (88.1)	85 (87.6)	0.893	23884 (85.3)	677 (88.9)	0.006**	2142 (84.2)	86 (86.0)	0.627
CHD co-morbidity	569 (45.2)	13 (28.9)	0.031*	-	-	-	2590 (9.3)	57 (7.5)	0.096	454 (17.9)	19 (19.0)	0.768
DM co-morbidity	428 (34.0)	17 (37.8)	0.599	1294 (31.5)	31 (32.0)	0.922	6837 (24.4)	276 (36.2)	<.001***	647 (25.4)	36 (36.0)	0.018*
HYP co-morbidity	886 (70.4)	27 (60.0)	0.136	2590 (63.0)	57 (58.8)	0.389	-	-	-	1680 (66.0)	66 (66.0)	0.994
QOF target achievement[†]												
Last BP record within 9 months	-	-	-	-	-	-	18286 (65.3)	500 (65.6)	0.849	-	-	-
Normal BP (150/90) in last 9 months	-	-	-	-	-	-	20829 (74.4)	557 (73.1)	0.430	1907 (75.0)	67 (67.0)	0.073
Normal BP (150/90) in last 15 months	-	-	-	3451 (84.0)	80 (82.5)	0.688	-	-	-	-	-	-
Cholesterol record in last 15 months										1786 (70.2)	69 (69.0)	0.796
Cholesterol <5mmol/l in last 15 months		-	-	2816 (68.5)	58 (59.8)	0.067	-	-	-	1477 (56.9)	52 (52.0)	0.334
Anticoagulant/antiplatelet last 15 months	-	-	-	3002 (73.1)	69 (71.1)	0.667	-	-	-	1460 (61.7)	59 (62.8)	0.840[1]
Quadruple therapy[2]	-	-	-	1530 (51.9)	28 (41.2)	0.082	-	-	-	-	-	-
Betablocker	879 (69.8)	18 (40.0)	<.001***	2710 (66.0)	53 (54.6)	0.020**	-	-	-	-	-	-
ACEI/ARB	1051 (83.5)	28 (62.2)	<.001***	-	-	-	-	-	-	-	-	-

*p<0.05, **p<0.01, ***p<0.001.

[†]Refers to QOF guidelines 2012/13[17]

[1]If non-haemorrhagic (non-SMI n=2366& SMI n=94).[2] If registered with MI (non-SMI n=2951 & SMI n=68). All QOF management guidelines refer to records since registration with outcomes. CHD= coronary heart disease, MI=myocardial infarction, HYP=hypertension, DM=diabetes mellitus, BP=blood pressure, ACEI/ARB=angiotensin-converting enzyme inhibitor/angiotensin receptor blocker, TSH=thyroid stimulating hormone, EGFR=estimated glomerular filtration rate, BMI=body mass index, HbA1c=glycated haemoglobin test.

[2]MI drugs - "quadruple therapy" including statin, antiplatelet/anticoagulant, betablocker and ACEI/ARB prescription.

Table 4 Differences in Quality and Outcomes Framework (QOF) CVD prescribing targets[†] by serious mental illness (SMI) status adjusted for socio-demographic characteristics and primary care consultation frequency.

	Reference (non-SMI)	Unadjusted OR (95% CI)	Adjusted for socio-demographics OR[a] (95% CI)	Additionally adjusted for consultation rate OR[b] (95% CI)
Betablocker				
After CHD	1.00	0.62 (0.41 - 0.93)*	0.68 (0.44 - 1.05)	0.66 (0.42 - 1.01)
After HF	1.00	0.29 (0.16 - 0.53)***	0.29 (0.15 - 0.55)***	0.27 (0.14 - 0.52)***
ACEI/ARB				
After CHD	1.00	0.59 (0.36 - 0.97)*	0.55 (0.33 - 0.94)*	0.47 (0.27 - 0.80)**
After HF	1.00	0.33 (0.18 - 0.61)***	0.34 (0.18 - 0.66)***	0.31 (0.16 - 0.60)***
Antiplatelet/anticoagulant				
After CHD	1.00	0.95 (0.54 - 1.65)	1.04 (0.57 - 1.89)	0.94 (0.51 - 1.73)
After STIA	1.00	1.04 (0.68 - 1.60)	0.99 (0.62 - 1.59)	1.04 (0.64 - 1.69)
Statin				
After CHD	1.00	0.76 (0.45 - 1.28)	0.78 (0.45 - 1.36)	0.70 (0.40 - 1.23)
Quadruple therapy[1]				
After CHD	1.00	0.65 (0.40 - 1.06)	0.62 (0.37 - 1.04)	0.28 (0.34 - 0.98)*

*p<0.05, **p<0.01, ***p<0.001.

[†]Refers to QOF guidelines 2012/13[17]

ACEI/ARB=angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; CHD=coronary heart disease; HF=heart failure; [1]Quadruple therapy indicated in patients with history of myocardial infarction and includes statin, antiplatelet/anticoagulant, betablocker and ACEI/ARB medication.

[a]Adjusted for age (continuous), gender, ethnicity, and borough-level deprivation; [b] additionally adjusted for mean annual number of primary consultations.

Table 5 Serious mental illness (SMI) characteristics associated with Betablocker and ACEI/ARB prescribing among CHD/HF patients

	Betablockers if recorded with CHD or HF (n=3347)				ACEI/ARB if recorded with CHD or HF (n=3760)			
	n (%)	Unadjusted OR (95% CI)	Adjusted for socio-demographics OR[a] (95% CI)	Additionally adjusted for consultation rate OR[b](95% CI)	n (%)	Unadjusted OR (95% CI)	Adjusted for socio-demographics OR[a] (95% CI)	Additionally adjusted for consultation rate OR[b] (95% CI)
Non-SMI	3279 (68.3)	1.00	1.00	1.00	3677 (76.6)	1.00	1.00	1.00
SMI overall	68 (52.7)	0.52 (0.36 – 0.73)***	0.50 (0.35 – 0.73)***	0.48 (0.33 – 0.69)***	83 (64.3)	0.55 (0.38 – 0.79)***	0.49 (0.34 – 0.73)***	0.42 (0.28 – 0.62)***
SMI by diagnosis								
Schizophrenia	30 (50.0)	0.46 (0.28 - 0.77)**	0.42 (0.24 - 0.73)**	0.38 (0.22 - 0.67)***	36 (60.0)	0.46 (0.27 - 0.77)**	0.35 (0.20 - 0.60)***	0.27 (0.15 - 0.48)***
Bipolar affective disorder	8 (40.0)	0.31 (0.13 - 0.76)*	0.37 (0.15 - 0.94)*	0.35 (0.14 - 0.90)*	11 (55.0)	0.37 (0.15 - 0.90)*	0.49 (0.18 - 1.26)	0.41 (0.16 - 1.09)
Other non-organic psychoses	8 (61.5)	0.74 (0.24 - 2.27)	0.78 (0.25 - 2.42)	0.75 (0.24 - 2.33)	12 (92.3)	3.66 (0.48 - 28.2)	3.81 (0.49 - 29.4)	3.44 (0.44 - 26.7)
Depot injectable								
No	42 (56.8)	0.61 (0.38 - 0.97)*	0.58 (0.36 - 0.96)*	0.56 (0.34 - 0.92)*	48 (64.9)	0.56 (0.35 - 0.91)*	0.49 (0.29 - 0.81)**	0.43 (0.26 - 0.72)***
Yes	11 (36.7)	0.27 (0.13 - 0.57)***	0.26 (0.12 - 0.60)**	0.22 (0.09 - 0.52)***	18 (60.0)	0.46 (0.22 - 0.95)*	0.41 (0.18 - 0.91)*	0.32 (0.14 - 0.72)**
Typical antipsychotic								
No	28 (50.9)	0.48 (0.28 - 0.82)**	0.50 (0.28 - 0.89)*	0.49 (0.27 - 0.86)*	34 (61.8)	0.49 (0.29 - 0.85)*	0.42 (0.23 - 0.75)**	0.37 (0.21 - 0.67)***
Yes	25 (51.0)	0.48 (0.27 - 0.85)*	0.44 (0.24 - 0.81)**	0.39 (0.21 - 0.73)**	32 (65.3)	0.57 (0.32 - 1.03)	0.52 (0.28 - 0.97)*	0.42 (0.22 - 0.80)**
Atypical antipsychotic								
No	8 (87.1)	0.62 (0.21 - 1.78)	0.59 (0.20 - 1.71)	0.54 (0.18 - 1.58)	8 (57.1)	0.41 (0.14 - 1.18)	0.41 (0.14 - 1.20)	0.32 (0.10 - 0.96)*
Yes	45 (50.0)	0.46 (0.31 - 0.70)***	0.45 (0.29 - 0.71)***	0.43 (0.27 - 0.67)***	58 (64.4)	0.55 (0.36 - 0.86)**	0.47 (0.30 - 0.76)**	0.41 (0.26 - 0.66)***
Any indicator of severity[1]								
No	45 (57.0)	0.61 (0.39 - 0.96)*	0.56 (0.35 - 0.91)*	0.54 (0.33 - 0.87)*	56 (70.9)	0.74 (0.46 - 1.21)	0.61 (0.37 - 1.01)	0.52 (0.31 - 0.87)*
Yes	23 (46.0)	0.39 (0.23 - 0.69)***	0.43 (0.24 - 0.77)**	0.39 (0.21 - 0.71)**	27 (54.0)	0.36 (0.20 - 0.63)***	0.37 (0.20 - 0.66)***	0.31 (0.17 - 0.56)***
Any indicator of risk[2]								
No	54 (59.3)	0.68 (0.44 - 1.03)	0.64 (0.41 - 1.00)	0.61 (0.39 - 0.96)*	64 (70.3)	0.72 (0.46 - 1.14)	0.65 (0.40 - 1.04)	0.56 (0.35 - 0.91)*
Yes	14 (36.8)	0.27 (0.14 - 0.52)***	0.28 (0.14 - 0.57)***	0.25 (0.12 - 0.51)***	19 (50.0)	0.31 (0.16 - 0.58)***	0.27 (0.14 - 0.54)***	0.22 (0.11 - 0.44)***

*p<0.05, **p<0.01, ***p<0.001.

ACEI/ARB=angiotensin-converter enzyme inhibitor/angiotensin receptor blocker.[1] Includes any of: ever had an inpatient stay, any record of being treated under the Mental Health Act, any record of difficulty managing their physical health, or any record of an Assertive Outreach/Crisis/A&E episode. [2]Includes any of: recorded history of violence, recorded history of non-compliance, and any record of a forensic history.

[a]Adjusted for age (continuous), gender, ethnicity, borough-level deprivation and recorded coronary heart disease/heart failure; [b] additionally adjusted for mean annual number of primary consultations.